GOAL PROGRAMMING APPLICATIONS IN FINANCIAL MANAGEMENT

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ABSTRACT

This paper examines the applications of goal programming to multiple-objective financial management decision situations. Over 80 articles are included from over 20 major accounting, finance, banking, and management science journals in the past 30 years.

The paper indicates the existing application areas of corporate budgeting and financial planning, working capital management, capital budgeting, financing decisions, merger and acquisition, investment planning/portfolio selection, commercial bank management, insurance management and pension fund management, scheduling staff, interest rates and risk, portfolio modeling, accounting control, and government and public firms. It lists the specific journals and the number of relevant articles from each. It also presents a summary of the number of relevant articles in each application area. The review shows that goal programming has been widely applied to financial management problems during the past 15 to 20 years.

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In some situations the application of goal programming to financial problems has led to extensions in the methodology of goal programming. Those extensions are summarized here.

In addition, this paper summarizes some of the limitations in the application of goal programming in the financial dimension. It is found that over the years there have been few documented cases of the use of goal programming in financial applications. Further, little evidence to date indicates that academics have used goal programming to solve more academic problems.

I. INTRODUCTION

Since the development of goal programming by Charnes and Cooper (1961) in 1961, there has been substantial research into applying goal programming to finance and accounting problems. This paper illustrates the breadth of those applications, listing over 80 applications in 12 different application areas, within finance and accounting. Further, those papers have appeared in journals representing a broad range of disciplines, including accounting, banking, finance, financial planning, and management science.

A. Purpose of this Paper

The purpose of this paper is to identify goal programming applications and methodological extensions relevant to the needs and interests of researchers in financial applications of goal programming, and ultimately of interest to financial managers. A summary of these applications should facilitate further research, motivate more active use of these applications in real world settings, and alert researchers and practitioners to what has already been done.

In many situations, the applications identified in this paper often were designed to solve specific problem applications. However, in some instances, new developments and interpretations of goal programming were necessary to accommodate the applications. Thus, the papers discussed in this paper include both applications and methodological analyses. However, throughout the primary focus is on the applications.

B. Goal Programming

Although there is not universal agreement as to the definition of goal programming (Zanakis and Gupta, 1985), it is promulgated as an aid for decision-making problems with multiple, possibly conflicting goals. Typically, linear goal programming attempts to minimize a weighted sum of deviations from goals. Surveys of goal programming are available in a number of books, including, Lee (1972).

Several classes of goal programming can be obtained, depending on the nature of the goal functions, decision variables, and coefficients (Zanakis & Gupta, 1985). For example, goal functions may be linear or nonlinear; decision variables may be continuous, discrete, or mixed; discrete variables may be either 0–1 integer or any integer; and coefficients can be deterministic, stochastic, or fuzzy.

C. Previous Surveys

There have been a number of surveys of goal programming applications over the years, but none recently. Charnes and Cooper (1961) provided the foundation for the application of goal programming to finance and accounting. In 1980, Lin (1980a) provided a survey of goal programming applications in a number of areas, including finance and accounting. In 1985, Zanakis and Gupta (1985) extended that study. Since there have been so many applications of goal programming this paper takes a more specific approach, focusing on the applications in finance and accounting.

D. This Paper

This paper proceeds as follows. Section II outlines the approach used in this study to find and classify the research papers. Section III provides brief discussions of selected papers in each of the application areas. These application areas include corporate budgeting and financial planning; working capital management; capital budgeting; financing decisions; mergers, acquisitions and divestitures; investment planning/portfolio selection; commercial bank management; insurance management and pension fund management; scheduling financial staff; interest rates and risk; government, hospitals, and public firms; and accounting control. Section IV provides a brief summary of some methodological developments that have occurred to accommodate financial applications in goal programming. Section V investigates some of the limitations of the literature to date. The final section briefly summarizes and concludes the paper.

II. APPROACH

The approach used in this paper was to identify the journals and proceedings that included papers in the area of goal programming in finance and accounting. A comprehensive analysis of those journals was made in an effort to find the appropriate application papers. The time span over which the journals were examined was approximately (because of different publication availabilities) 1961 to 1990. This span was chosen because of the desire to update the Lin (1980a) study (in the area of finance and accounting) for the most recent decade, and thus to provide an analysis of the developments over the last 30 years. A summary

Table 1. Goal Programming Applications to Financial Management

Journal	*Number of articles*
Proceedings	11
Financial Management	9
Advances in Mathematical Programming and Financial Planning	8
OMEGA	8
Decision Sciences	7
Journal of Business Finance and Accounting	7
Management Science	4
Financial Review	3
Accounting and Business Research	3
Engineering Economist	3
Journal of Bank Research	2
Journal of Business Research	2
Journal of Finance	2
Journal of Risk and Insurance	2
Management Accounting	2
Management International Review	2
Accounting Review	2
Cost and Management	1
Journal of Accounting Research	1
Journal of Commercial Bank Lending	1
Journal of Money, Credit and Banking	1
Journal of Portfolio Management	1
Operations Research	1

of these journals and the numbers of papers found in each of them is given in Table 1.

Efforts were made to ensure that most of the relevant applications would be found. However, inevitably some important papers are missed. This is easy to do since the span of journals is so broad and the titles and authors are not necessarily indicative of the content of the paper. In addition, many good papers are published in proceedings, so it is difficult to find them. The reader who is aware of omissions (or errors) should please contact the authors.

Then each of the journal papers was put into a category used to characterize the specific application. Although other researchers may have categorized the papers differently, typically the two authors agreed on the categorizations

Table 2. Goal Programming Applications by Basic Application Areas

Application Area	*Author*
Corporate budgeting and financial planning	Charnes et al. (1983), Guerard and Lawrence (1987), Hindelang and Krishnamurthy (1985), Jagetia and Nelson (1976), Kvanli (1980), Kvanli and Buckley (1986), Lawrence et al. (1981), Lin (1978), Mulvey (1987), Nunamaker and Truilt (1987), Sheshai et al. (1977), Turk and Selman (1981)
Working capital management	Cox (1981), Hollis (1979), Keown and Martin (1977), O'Leary and O'Leary (1981), Philippatos and Christofi (1984), Rakes and Franz (1985), Sartoris and Spruill (1974)
Capital budgeting	Bernhard (1980), Bhaskar (1979, 1980), Bhaskar and McNamee (1983), Chateu (1975), Gonzales et al. (1987), Hawkins and Adams (1974), Ignizio (1976), Keown and Taylor (1978), Lin (1976), Merville and Tavis (1974), Spahr et al. (1987), Thanassoulis (1985)
Financing decisions	Arthur and Lawrence (1985), Ashton, (1985, 1986), Jones (1979), Maimon and Porter (1987)
Mergers, acquisitions and divestitures	Charnes et al. (1988), Fowler and Schnniederjans (1987), Lawrence et al. (1976)
Investment planning/portfolio selection	Callahan (1973), Harrington and Fisher (1980), Kumar and Philippatos (1979), Kumar et al. (1978), Lee and Chesser (1980), Lee and Lerro (1973, 1978), Muhlemann (1978), Muhlemann and Lockett (1980), Shar and Musser (1986), Stone and Reback (1975)
Commercial bank management	Booth and Dash (1977), Fortson and Dince (1977), Keown (1978), Lam and Karwan (1985), Lee et al. (1971), Sealey (1977, 1978), Trennepohl (1975), Turshen and Nolley (1987)
Insurance management and pension fund management	Drandell (1977), Gleason and Lilly (1977), Klock and Lee (1974), O'Leary and O'Leary (1987)
Scheduling financial staff	Balachandran and Steuer (1982)
Interest rates and risk	Booth and Ressler (1989), Boquist and Moore (1983), Gressis et al. (1985), Hong (1981)
Government and public firms	Charnes et al. (1988), Guerard and Buell (1984), Jackman (1973), Joiner and Drake (1983), Keown and Martin (1976, 1978), O'Leary and O'Leary (1982), O'Leary (1990), Olve (1981), Taguchi et al. (1983), Trivedi (1981), Wacht and Whitford (1976), Wallenius et al. (1978)
Accounting control	Kornbluth (1985, 1986), Lin (1979, 1980b)

presented. Individual authors may disagree with the category in which we placed their paper (s). If there is a disagreement, again please contact the authors.

A dozen different categories empirically were generated. The categories were developed wholly in response to the papers that were found. Those categories and the papers falling within those categories are summarized in Table 2.

III. FINANCIAL AND ACCOUNTING APPLICATIONS OF GOAL PROGRAMMING

This section summarizes many of the over 80 applications found in a review of the literature. The applications, categorized in 12 different categories, are summarized in Table 2. For each of these areas, we briefly will summarize some of the applications.

A. Corporate Budgeting and Financial Planning

The earliest goal programming application example in financial management is by Charnes et al. (1963), in the area of budgeting. They used the goal programming formulation to show the balance sheet extension of break-even analysis. Lin (1979) extended that analysis to an example of two products, with contribution margin and sales as the two goals. Sheshai et al. (1977) assumed a piecewise linear variable cost function and a step function for fixed cost. They used zero–one integer programming to compute break-even point for a two-product example with a no-priority goal situation.

Charnes et al. (1963) extended break-even analysis for a product mix budgeting model. They showed how goal programming might be joined with accounting in order to produce coordinated budgetary planning control, and examined some of the possible relations between mathematics and accounting. Jagetia and Nelson (1976) gave one example of a goal programming formulation for hospital budgeting with goals of profit and number of patient days. This model has three types of constraints: operating room hours, recovery room hours, and nursing hours. Lin (1978) presented a modified product mix budgeting model to incorporate uncertain demand with profit, sales, and capacity utilization goals. Kvanli (1980) also reported the corporate budgeting goal programming application at Texas Instruments Inc. He incorporated 19 goals into the budgeting model: sales, profit margin, profit per employee, EPS, net fixed assets—facilities, net fixed assets—equipment, other-assets-to-sales ratio, end-of-year assets, sales-to-average-assets ratio, profit-to-average-assets ratio, total capital expenditures, capital expenditures—facilities, capital expenditures—equipment, capital-expenditures-to-sales ratio, depreciation-to-sales ratio, number of employees, sales per employee, payroll, and sales-to-payroll ratio.

B. Working Capital Management

Hollis (1979) presented a single-period, multicountry goal programming model for centralized corporate planning utilizing a cash-pooling center, with emphasis on short-term investing and financing. The model is based on the new exposure concept, and the firm is assumed to strive for an ending exposure balance as close to zero in each country of operation.

Keown and Martin (1977) gave one example of a chance-constrained goal programming model for working capital management. Their model included one profit-economic goal, two chance-constrained transaction balance goals (maintain a cash buffer and a minimum level of inventory), two chance-constrained liquidity goals (current ratio and acid test ratio), and two chance-constrained debt usage goals (debt-to-total-asset ratio and fixed-charges coverages ratio).

O'Leary and O'Leary (1981) developed a goal programming model for the cash management problem. Their model extended the basic single-objective cash management formulations to include multiple objectives.

Sartories and Spruill (1974) formulated a goal programming working capital management model with four goals: profit, cash balance, current ratio, and quick ratio.

C. Capital Budgeting

There are many goal programming formulations of capital budgeting models in the literature (See Table 2).

Hawkins and Adams (1974) gave an illustration of goal programming applied to capital budgeting, which directly incorporated the existence of multiple conflicting goals. Their example model included net present value, sales, and man-hour employment goals. Ignizio (1976) illustrated a capital budgeting goal programming problem with profit and market coverage objectives. He also mentioned that the model has been applied to several military-related program selection problems with three to five objectives.

Lee and Lerro (1974) had four comprehensive capital budgeting models. They incorporated the following eight goals: budget allocation, interperiod transfer of budget funds, mutually exclusive project, maximizing net present value of the firm, income growth, maximization of cash inflow for a particular year, buying pollution equipment in a particular year, minimizing liquidity, and maximizing total cash flow.

Keown and Taylor (1978) presented a general capital budgeting goal programming model for the firm. Their example has the following goals: net present value, overall sales growth, profit, market share, public service image, product innovation, limitation of risky ventures, limitation of the degree of reliability on general economy, management depth, and budget expense. Bhaskar (1979) also developed a general goal programming model of capital budgeting with the following goals: investment, dividend, short-term borrowing, long-run debt, new equity issue, debt/equity ratio, profitability, turnover/market share, and product quantity.

Keown and Martin (1976) illustrated an integer goal programming model for capital budgeting in hospitals. They listed the following goals and priorities: budget ceiling; accreditation (acceptance of at least some proposals), legal minimum spending, political or social acceptance of at least some important products, blood

diagnosis performance, respiratory diagnosis performance, coronary diagnosis performance, and cancer diagnosis performance.

Wacht and Whitford (1976) also mentioned capital investment analysis in nonprofit teaching hospitals. They listed seven goals and priorities: facilitation of teaching and research, creation of a center of excellence in health care, maintenance of a skilled and motivated force of health care workers, evaluation of the standards of health care in the community, improvement of the social and economic climate in the community, and provision of effective management in order to achieve institutional efficiency and effectiveness.

D. Financing Decisions

Arthur and Lawrence (1985) developed a model to analyze the make or buy decision. Their approach takes into account the multiproduct environment, overtime levels, and capital utilization affects.

Jones (1979) applied goal programming to small-firm financing decisions. He listed five goals with a sensitivity analysis on the rotation of priorities: achieve or exceed the financing goal or total capital needs, keep the annual debt payment low, make optimum use of long-term debt funds, limit the use of debt capital (which requires collateral as well as a lot of red tape), and meet the total cost of capital goal.

E. Mergers, Acquisitions, and Divestitures

Fowler and Schniederjans (1987) formulated a zero–one goal programming model for strategic analysis of potential acquisitions. In particular, the model allows the decision-maker to analyze critical acquisition factors and to examine the potential for synergy.

Lawrence et al. (1976) illustrated an acquisition investment problem in terms of the following constraints: maximum budget, minimum total earnings, and the minimum cash flow. These have the following four goals and priorities: present worth of firm's goal level of internal rate of return on all acquisition investments, present worth of firm's future revenue growth potential, amount of debt financing for acquisition investments, and amount of assets-to-liability ratio for all acquisition investments.

F. Investment Planning/Portfolio Selection

Callahan (1973) illustrated one goal programming investment planning model with profit and risk or safety goals. Lee and Lerro (1974) used empirical data from 61 companies in 10 industry groups for 1958–1968 to establish a goal programming portfolio selection model with four priorities and six types of goals: expected portfolio return, portfolio variance, covariance, dividend yield, unexplained price

variance, and investment budget. Lee and Chesser (1980) also illustrated a portfolio selection model with the following goals: portfolio return, and percentage of investment in different beta risk securities. Stone and Reback (1975) developed a portfolio model with risk and dividend goals subject to transaction costs.

Kumar and Philippatos (1979) applied goal programming to the investment decision of dual-purpose funds. An empirical demonstration is provided to show that dual-purpose funds managers can improve their investment selection and subsequent performance by the use of goal programming methodology. They identified the following goals: systematic risk, unsystematic risk, income return, capital return, individual security allocation, and cash allocation. Kumar et al. (1978) also showed the similar goal programming mode for the selection of portfolios by dual-purpose funds.

In a sequence of papers, Muhlemann et al. (1978), Muhlemann and Lockett (1980), and Harrington and Fischer (1980) examined the problem of multiobjective project selection. Muhlemann et al. (1978) developed a stochastic integer program with recourse that includes as the objective function a weighted linear combination of deviations from set values for two goals. Harrington and Fischer (1980) proposed integer goal programming and simulation to solve the problem.

G. Commercial Bank Management

Trennepohl (1975) showed an application of goal programming to bank asset management with the following goals in the same priorities: meet federal banking regulations, achieve adequate safety in the bank's investments, achieve adequate liquidity in the bank's assets, achieve certain characteristics of the loan portfolio, achieve certain characteristics of the securities portfolio, and obtain a certain level of earnings from the investments.

Fortson and Dince (1977) used goal programming to develop a model that incorporates the multiple and conflicting goals of profit, capital adequacy, liquidity, and loan-to-deposit ratio. The model provides quarterly balance sheets, income statements, and goal deviations. Management was found to get a direct benefit from seeing the quantified results of setting and ordering their goals, given a scenario.

Keown (1978) presented a bank liquidity model formulated as a chance-constrained goal programming model with one profit goal and the following five chance-constrained goals: loan buffer, cash buffer, correspondent bank deposit balance, legal reserve requirement, and 2% legal carryover. Testing of the model was performed on two banks—a small rural one with assets of about $25 million and a large metropolitan institution with assets well in excess of $1 billion. Actual bank results and the prescribed strategy of the model were compared over a one-year period. Sensitivity analysis was performed on the model, offering valuable information concerning risk/return relationships associated with each management goal. This model offers bankers diagnostic planning for decisions.

Sealey (1977, 1978) developed a goal programming bank financial planning model with the following goals: profit, capital adequacy ratio, and risk-asset-to-capital ratio. This model also has the following constraints: capacity adequacy, diversification, required reserves, and balance sheet.

Turshen and Nolley (1988) developed a model to assist in the process of selecting a clearing agent for check collection in a commercial bank. The model they constructed took into account item charges, collection time, collection time spread, processing hours, transportation cost, account costs, batching requirements, and financial health.

H. Insurance Management and Pension Fund Management

Klock and Lee (1974) suggested a goal programming model for a property liability insurer with profit, current asset returns, and legal bounded goals. Drandell (1977) demonstrated that the goal programming model developed is equivalent to the original linear programming model of optimum allocation of assets.

Gleason and Lilly (1977) applied the goal programming technique to insurance agency asset management with four priorities and the following six goals: premium expansion, number of insurer expansion, individual insurer premium, cost reduction, maximizing gross income, and commercial/personnel ratio. The goal programming approach provides agency management with guidelines concerning the suggested level of premiums to be written for each insurance class. It also indicates how the agency should divide the premiums in a class among insurers, if the appropriate levels of premiums are achieved.

O'Leary and O'Leary (1987) used goal programming to address a problem faced by the financial and personnel departments in many firms: choosing an investment manager. The model considered some of the many objectives identified in a field study of the process of choosing a portfolio manager.

I. Scheduling Financial Staff

At least one paper has been concerned with a multiple-criterion analysis of staff planning. Balachandran and Steuer (1982) developed an interactive model to assist a certified public accounting firm in audit staff planning. The multiple objectives included such items as maximizing profit, accommodating bookings, avoiding unnecessary audit staff increases and decreases, minimizing underutilization of staff, and achieving professional development goals.

J. Interest Rates and Risk

The management of risk is a critical issue to banks (e.g., interest rate risk), firms (different divisions have different risks), and finance mix and capital risk, in general. Booth and Bessler (1989) developed a prototype goal program for interest

rate risk using two different approaches: forecast model and duration model. The duration model only needed information about the direction of the interest rate changes, while the forecast model needed both direction and magnitude.

Hong (1981) used a goal programming model including goals on total finance mix of the firm, earnings per share, average rate of return, limits on debt financing, and legal or other restrictions.

K. Government, Hospitals, and Public Firms

Some of the best papers in the area of financial applications of goal programming have been done in this application area. Some of these are discussed in more detail in the section on limitations of the literature, because of the quality of these papers.

Many of these papers did not just formulate a model, but instead also implemented it with real data. Often the results reported in these papers directly influenced management decision-making behavior.

In part, these studies may be more complete than other studies because of the ability to disclose data (e.g., publicly available), without consequences. In addition, in many of these situations, the different constituencies and their goals are well established. The disclosure of a conflicting set of goals would not cause the difficulties that it may in a private firm, where to disclose the different sets of goals may reveal information to competitors. Instead, in many such public situations, the goals are well-known and publicity of the fact that the goals were being considered may well be regarded positively ("the government that cares").

L. Accounting Control

One of the primary uses of goal programming in accounting has been to investigate performance evaluation using an ex post variance analysis. Lin (1980a) developed a multiple-goal approach to the variance problem, using an opportunity cost concept as a control device. Kornbluth (1986) extended that research to show how a "preference" variance could be introduced into an accounting scheme using goal programming. The preference variance measures the proportion of the total variance that could or should be attributed to changes in management's preferences.

IV. METHODOLOGICAL EXTENSIONS

In some cases the specificity of the financial applications required that researchers address methodological issues. This section summarizes some of those extensions.

Probably the most accepted methodology for analyzing financial problems is simulation. Ashton (1985, 1986) addressed the issue of integrating goal programming and simulation analysis. The focus was on using goal programming to understand the multitude of measures deriving from the simulation. In particular,

that research was aimed at describing one approach to endowing a simulation model with multiple-criterion intelligence.

Often the goal programming approach is structured independently of the user. Gonzalez et al. (1987) developed an interactive system for capital budgeting, using a linear and integer search procedure.

Hindelang and Krishnamurthy (1985) integrated goal programming and linear programming decomposition analysis. They recommended a strategic planning model that used different objective functions at the strategic and tactical levels.

Kornbluth (1985) investigated a sequential multicriterion decision-making problem. The example was drawn from market trading situations where a dealer is presented with a sequence of offers. Using simple programming techniques, it is shown that a great deal of the decision-making can be automated.

Mulvey (1987) investigated the relationship between several network planning models for multiperiod portfolio problems and nonlinear programming. He found that the special nature of the network constraint set matrix can be used to yield very efficient nonlinear programming algorithms.

Rakes and Franz (1985) developed a method for interpreting underachievement in chance-constrained goal programming. Their interpretation was in terms of probabilities rather than strict deviations. They claimed that this approach provided the user with more information for postoptimality analysis.

V. LIMITATIONS OF THE LITERATURE

Goal programming is a relatively new operations research technique, but it is now over 30 years old. Unfortunately, the same criticism that authors leveled at goal programming 8 years ago (Zanakis and Gupta, 1985) 13 years ago (Lin, 1980a) and probably 18 and 23 years ago is still valid. There is little evidence, in the studies that are published using goal programming, that goal programming is actually being implemented. This evidence is in concert with the survey evidence (e.g., Zanakis, 1985) that goal programming has received limited usage and the respondents have only limited awareness of it.

However, there are other limitations in the literature of goal programming. There is little evidence that goal programming is a useful tool to analyze behavior in a descriptive manner. For example, linear regression has been used frequently to investigate archival data to try to understand and describe behavior. If, as claimed in virtually all goal programming papers, people have multiple goals, then we would expect to find their behavior more consistent with goal programming solutions than with single-goal solutions. However, there are few studies of this type in the literature.

Finally, there is little evidence that goal programming is being used by academics to address issues of academic concern. Academics employ many methodologies to

investigate theories in more detail. However, to date, goal programming has been used only sparingly as a research methodology.

A. Real World Applications

Clearly there are exceptions to these charges. Charnes et al. (1988) showed the power of the approach in the analysis of the Bell system break up. Olve (1981) used goal programming to analyze a problem facing the Swedish National Telecommunications Administration, involving multiple success measures for local telephone service. Taguchi et al. (1983) prepared a model for developing countries, and the marine industry in particular. Wallenius et al. (1978) developed an approach that was used to analyze macroeconomic problems in Finland.

Each of these studies has two ingredients that many other studies did not have. First, each of these papers was associated with a governmental decision problem. In these situations, it was anticipated that either the data were publicly available, the authors were involved in the project beyond the sole development of a goal programming model, or both.

Although there have been studies on existing businesses [e.g., Kvanli and Buckley (1986) on Texas Instruments and Keown (1978) on a bank], few other papers have disclosed actual data. It may be that other studies had to camouflage the model, the data, and the results, because of corporate constraints. This may lead to an underestimate of the extent of use of goal programming models.

Second, each of the decision problems had established constituencies representing the need for different goals. In many corporate situations, top management establishes the relative importance of different goals. The hierarchical nature of business organizations may mitigate the need for a tool like goal programming. Further, as noted earlier, it may not be appropriate for a business to disclose the multiple goals of its different constituencies.

These two reasons are hypotheses in search of addition empirical evidence. In addition, there are other reasons for the lack of use of goal programming. For example, Ashton argues that "many current goal programming formulations proposed for financial planning are unlikely to produce usable solutions" (1986, p. 83).

B. Empirical Analysis for Estimation of Behavior

A major concern to the theory of goal programming appears to be, do people actually use multiple-goal models in their decision-making? If not, then maybe goal programming is not an appropriate tool for decision-makers. Although, a priori, it is easy to assume that people do use multiple criteria, in order to substantiate that hypothesis descriptive work needs to be done, mapping goal programming solutions and human behavior. After all, as noted above, surveys indicate little use of goal programming. Some research has been done in this area using archival data. Gressis et al. (1985) used goal programming to estimate divisional beta coefficients,

using Value Line. They assumed that two to four goals should be used (capital intensity, asset size, coefficient of variation in net income, and coefficient of variation in sales). They found that the goal programming–derived betas were best using two goals.

Guerard and Buell (1981) used goal programming to examine the determinants of the dividend, investment, liquidity, and financing decisions of public utility firms. They investigated the importance of the underachievement of dividends, investment, and liquidity in the planning process.

C. Academic Research

Many of the papers listed here addressed problems of direct concern to practitioners (e.g., cash management, working capital management). Although practitioners are one constituency, academicians are another.

To date, there are only limited papers in financial goal programming to address academic issues. For example, Lin (1980b) and Kornbluth (1986) both investigated the use of goal programming to characterize previous theoretical investigations in accounting control. In addition, Boquist and Moore (1983) used goal programming to estimate the systematic risk associated with different divisions. Although in many cases, it is difficult to determine what is an academic issue and what is a practical issue, few other issues of primarily academic interest appear to have been investigated using goal programming.

VI. CONCLUSION

The idea of goal programming was first suggested by Charnes and Cooper in 1961. During 1961–1970 there was only one goal programming application article in the literature, by Charnes et al. (1963). Since the publication of a goal programming computer program by Lee in 1972, there have been many application articles in the literature. This paper has classified the financial management applications in the areas of corporate budgeting and financial planning, working capital management, capital budgeting, financing decision, merger and acquisition, investment planning/portfolio selection, commercial bank management, insurance and pension fund management, scheduling financial staff, interest rates and risks, government and public firms, and accounting control. In addition, this paper has summarized some of the extensions to goal programming methodology resulting from the development of financial and accounting models. Finally, some of the limitations of the literature on goal programming in finance and accounting were discussed.

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